MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

SUPPLEMENTARY EXAMINATION

TRIMESTER 1, 2015/2016

EEE1016 – ELECTRONICS 1

(All Sections / Groups)

19 NOV 2015
2.30 PM – 4.30 PM
(2 HOURS)

INSTRUCTION TO STUDENTS

1. This Question paper consists of **5 pages** including cover page with **4 Questions** only.

2. Attempt **ALL** the questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the answer Booklet provided.

QUESTION 1

(a) Explain why the electric current in a conductor is unipolar due to the flow of electrons only but the electric current in a semiconductor is bipolar due to the flow of electrons and holes at room temperature. [5 marks]

(b) Explain how the conductivity of pure silicon can be increased by doping with impurities to produce an n-type semiconductor. [4 marks]

(c) Consider a semiconductor sample at 300 ^{o}K having doped by 8 x 10^{14} donor atoms/cm^3 and 2×10^{14} acceptor atoms/cm^3. Given that n_i = 1.75 x 10^{13} cm^{-3}, μ_n=4000 cm^2/V-s and μ_p = 2000 cm^2/V-s.

(i) Determine the concentrations of holes and electrons. [6 marks]

(ii) What type of semiconductor is obtained? Explain. [2 marks]

(iii) Calculate the drift current density if an electric field of 2 V/cm is applied to the semiconductor. [3 marks]

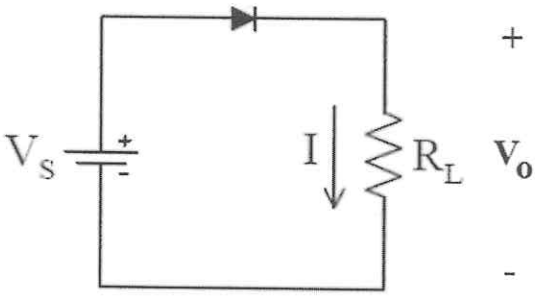

Figure Q1

(d) The diode in the circuit shown in Figure Q1 can be represented by the piecewise linear model with $V\gamma$ = 0.3 V and R_f = 12 Ω. Determine the output voltage V_o and current I in the circuit if V_S = 12 V and R_L = 5 kΩ. [5 marks]

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QUESTION 2

The rectifier shown in Figure Q2 is supplied from a 210 V, 60 Hz source. The output resistance R_L is 1 kΩ, capacitance C = 50 μF and the voltage drop across forward-biased diode D is 0.7V. Find the following values:

(i) Determine the peak voltage $V_{p(m)}$ across the primary winding of the transformer. [2 marks]

(ii) Calculate the *rms* and peak values of the secondary voltage V_1. [4 marks]

(iii) Calculate the peak, the *rms* and the *dc* values of the output voltage of the rectifier, V_2. [6 marks]

(iv) From results obtain in part (i), (ii) and (iii), compute the ripple factor γ of the rectifier circuit. [2 marks]

(v) Calculate the peak and average values of the secondary output voltage V_5. [8 marks]

(vi) From the values obtained in part (e), calculate the ripple voltage V_r of the rectifier circuit. From the values obtained in part (e), calculate the ripple voltage V_r of the rectifier circuit. [3 marks]

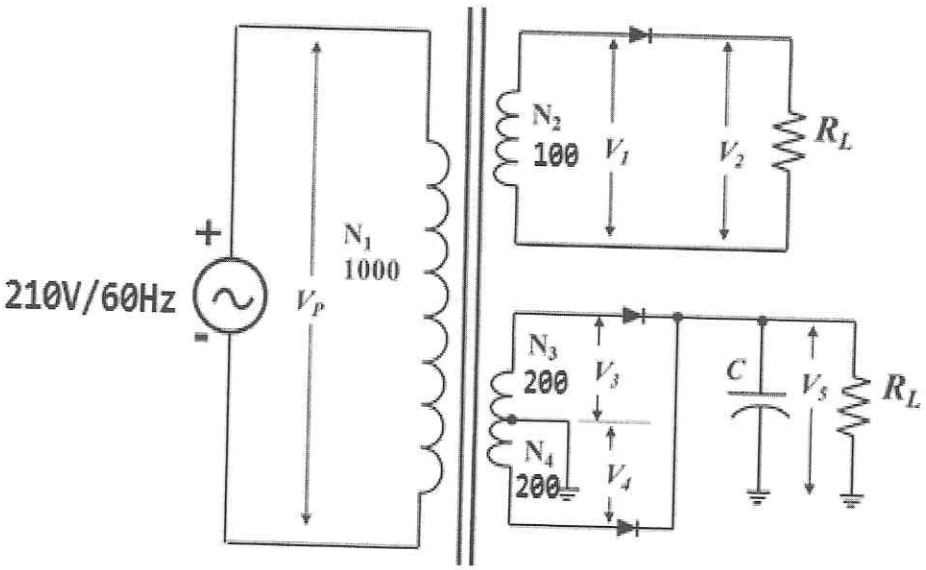

Figure Q2

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QUESTION 3

(a) With proper labelling, illustrate the output characteristics of a common-emitter configuration of BJT and indicate the steps to determine the DC load-line and the values of I_{BQ}, I_{CQ} and V_{CEQ} of common-emitter amplifier. [2+4 marks]

(b) Describe any THREE typical amplifier features of a common-emitter amplifier. [3 marks]

(c) For the amplifier circuit shown in Figure Q3, R_1 = 100kΩ, R_2 = 50kΩ, R_C = 5kΩ and R_E = 3kΩ. the amlifier circuit is connected to a DC supply, V_{CC} = 15V. Given that the amplification factor of the BJT, β = 100 and V_{BE} =0.7V.

(i) Draw the DC equivalent circuit of the amplifier circuit. [2 marks]

(ii) Simplify and draw thevenised DC equivalent circuit of the amplifier. [2 marks]

(iii) Determine the Thevenin's voltage, V_{TH}, and resistor, R_{TH}, of the simplified circuit. [4 marks]

(iv) Determine the emitter current I_E and the base current I_B. [4 marks]

(v) Determine the voltages at V_B , V_E and V_C nodes [4 marks]

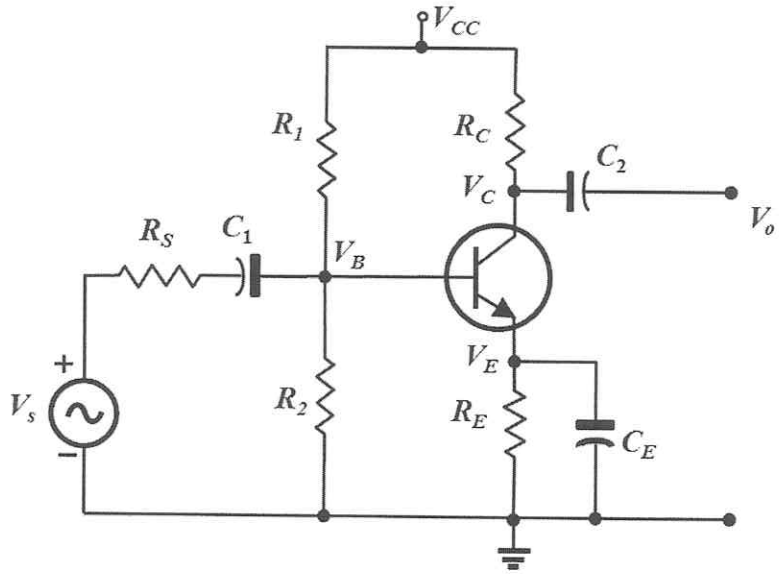

Figure Q3

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Question 4

(a) Describe the impact for having a negative gain on the input and output current or voltage signal relationship for an amplifier circuit. [3 marks]

(b) Describe three rules of thumb to be followed when constructing a transistor amplifier's AC equivalent circuit. [3 marks]

(c) A current signal of 0.05mA was injected into the input of an amplifier circuit, and 15 mA current was obtained at the output of the amplifier. How much has the input current been amplified? [2 marks]

(d) Figure Q4(d) below shows a BJT amplifier circuit. The transistor base-emitter voltage, V_{BE}, and Early voltage, V_A, are given as 0.7 V and 100 V, respectively. The current gain, β, of the BJT amplifier is given as 150.

(i) Determine whether the amplifier circuit of Figure Q4(d) is common-emitter, common-base or common collector. [2 marks]

(ii) Construct the small-signal r_e equivalent circuit for Figure Q4(d). [3 marks]

(iii) For the transistor r-parameters, calculate the emitter resistance, r_e, input resistance, r_b, and output resistance, r_o. [6 marks]

(iv) For the amplifier parameters, calculate the input resistance, R_{in}, and total AC load, R_L'. [4 marks]

(v) Calculate the voltage gain with load $(A_{v(WL)} = v_{o(WL)}/v_{in})$. [2 marks]

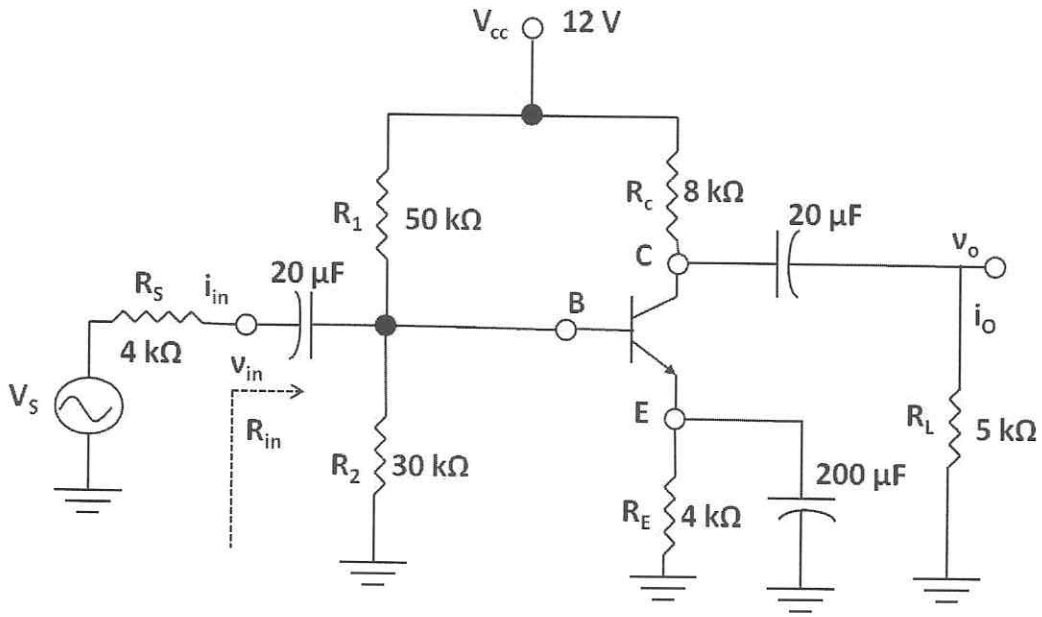

Figure Q4(d)

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